Australian Tactical Loads and their Operational Impacts

Orr, Rob Marc; Pope, Rodney

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Australian Tactical Loads and their Operational Impacts

Dr Rob Orr (PhD, PHTY, BFET, TSAC-F, ADFPTS)

https://bond.edu.au/tru

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

HISTORICAL CONTEXT – MILITARY

Background

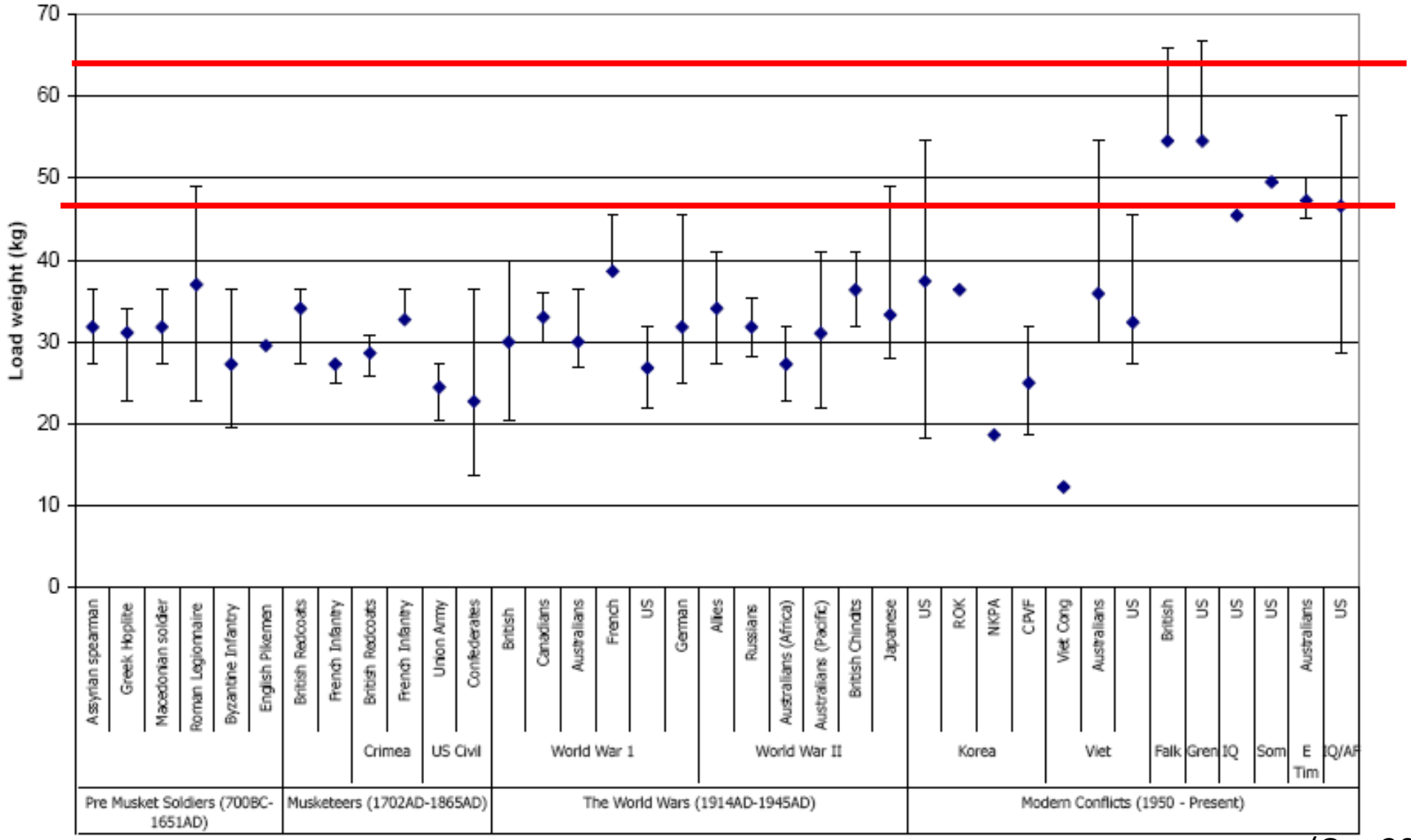
- From the early Assyrian spearman of antiquity (circa 800 B.C.), soldiers have been required to carry external loads consisting of weaponry, equipment and food

(Orr, 2010; Knapick et al., 2012:2004)

- Downstream effects of these loads have been shown to impact on the tactics of warfare, cause injury and reduce fighting force size

(Lee, 2007; Breen, 2002;Lothian , 1921)

HISTORICAL CONTEXT – MILITARY



Viet = Vietnam; Falk = Falklands; Gren = Grenada; IQ = Iraq; Som = Somalia; E Tim = East Timor; IQ/AF = Iraq/Afghanistan

(Orr, 2010: Orr et al., 2015)

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

CURRENT CONTEXT – AUSTRALIAN ARMY

On Operations (2001-2010)

- PO loads
  - M=28.4 ± 10.0 kg
    - heaviest mean load in 2008 (M=36.9±10.8 kg)
- MO loads
  - M=56.7 ± 15.3 kg
    - heaviest mean load in 2009 (M=65.1 ±16.3 kg)
- OVERALL loads
    - 47.7±21.0 kg, (mean range over 10 years = 40.7 kg to 50.9 kg),

(Orr et al., 2015)

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

CURRENT CONTEXT – AUSTRALIAN ARMY

- Approximate relative load carried by Roman Legionnaires = 56%
- Australian Soldiers in East Timor = 56%
- *US Soldiers in Afghanistan = 57%*

http://www.roman-empire.net/army/pics/marius-mules.jpg

1 Joint Public Affairs Unit - Achieves

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

ABSOLUTE VS RELATIVE LOADS

- Currently female soldiers carry lighter absolute loads than male soldiers but only slightly heavier relative loads

Orr et al (2015).

*ABSOLUTE LOADS**	*RELATIVE LOADS*
FEMALE: *M* = 26.4 kg	FEMALE: *M* = 43%
MALE: *M* = 39.0 kg	MALE: *M* = 47%
p=.045	**p=.55**

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

ABSOLUTE VS RELATIVE LOADS

- Currently lighter soldiers carry the same absolute loads as heavier soldiers but heavier relative loads

Orr et al (2015).

ABSOLUTE LOADS	*RELATIVE LOADS*
Light 20%: *M* = 34.7 kg	Light 20%: *M* = 49%
Heavy 20%: *M* = 35.7 kg	Heavy 20%: *M* = 36%
p=.902	**p=.0509**

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

HISTORICAL CONTEXT – LEO

http://2.bp.blogspot.com/-xHtSiLRFIMQ/UfewLRnEgAI/AAAAAAAAIpc/54yapn_ibtE/s1600/Curious+Black+&+White+Photographs+of+The+Police+Officers+from+1890–1930+(28).jpg

http://3.bp.blogspot.com/-HO26ffMhqS4/UiHkEhycroI/AAAAAAAAMR4/qGsg2ryfWKA/s640/Pictures+of+Life+of+the+New+York+Police+Department+in+the+1970's+(7).jpg

http://images.smh.com.au/2012/12/04/3861588/art-police-uniforms-620x349.jpg

http://images.smh.com.au/2009/03/09/410908/policebelt.jpg

http://www.gunblast.com/images/WBell_PoliceHolsterHist/Police-Holster-History-012.jpg

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

HISTORICAL CONTEXT – LEO

- Police are becoming Christmas trees

http://images.canberratimes.com.au/2012/06/24/3406073/art-23-3t24policewomen-420x0.jpg

http://img.dailymail.co.uk/i/pix/2008/04_03/TabGunGirlLEWIS_468x715.jpg

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

HISTORICAL CONTEXT - LEO

- Increasing levels of threat

Photograph taken by author

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

HISTORICAL CONTEXT – AUSTRALIAN LEO

ILAV type (A-C) & Normal station wear (N)	ILAV Weight (kg)	Duty load Complete (kg)	Total load including officer weight (kg)
A	4.12 ± 0.65*	11.53 ± 0.77‡	88.03 ± 20.49
B	3.54 ± 0.70*	11.01 ± 1.01‡	87.51 ± 20.60
C	3.24 ± 0.48*	10.77 ± 1.16‡	87.27 ± 20.66
N	NA	8.69 ± 0.68	85.19 ± 20.24

* Significantly different ($p<0.05$) between vests:
‡ Significantly different ($p<0.001$) from normal station wear

(Orr et al., 2016)

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

CURRENT CONTEXT – AUSTRALIAN LEO

	FEMALE	MALE	FEMALE	MALE
ILAV type	**ILAV + Duty Loads (kg)**	**ILAV + Duty Loads (kg)**	**%BW**	**%BW**
A	11.14	11.85	16.90	14.90
B	10.80	11.18	16.43	13.91
C	10.24	11.22	15.60	13.95
N	8.68	8.70	13.20	10.92
	*p=0.225		*p=0.009	

(Orr et al., 2016)

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

ABSOLUTE VS RELATIVE LOADS

- The LEO study found female officers carried the same absolute loads compared to the male officers
- However when expressed as a percentage of their body weight female officers carried significantly more relative load than male officers

(Orr et al., 2016)

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

CURRENT CONTEXT – AUTRALIAN LEO (TOU)

	Mean ± SD	Range
Absolute load carried (kg)	22.8 ± 1.8	20.6-25.6
Relative load carried (%BW)	25.9 ± 4.0	21.2-28.8

(Carbone et al., 2014; Carlton et al., 2014)

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

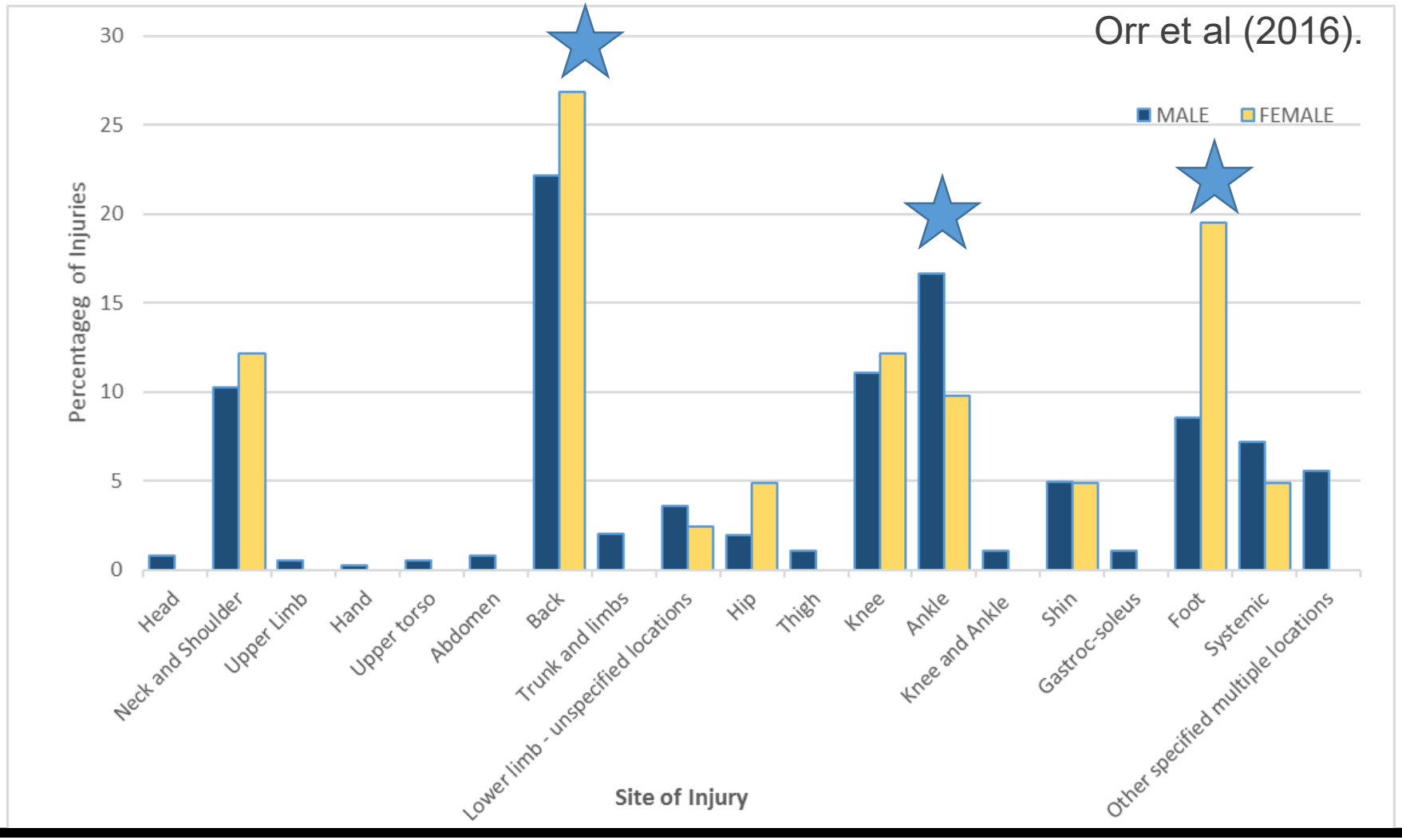
SEX DIFFERENCES IN LC INJURIES

Orr et al (2016).

- Mean ARA population over 2 years = 24,876 personnel
  - Female n= 2441 (10%): Male n= 22435 (90%)
- 401 reported injuries associated with load carriage
  - Female n=40 (10%): male n= 361 (90%)
  - RR = 1.02 (95% CI 0.74 to 1.41)
- SPI
  - Female n=6 (15%): male n= 23 (6%)
  - RR of SPI = 2.40 (95% CI 0.98 to 5.88)

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Orr et al (2016).



BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MARKSMANSHIP

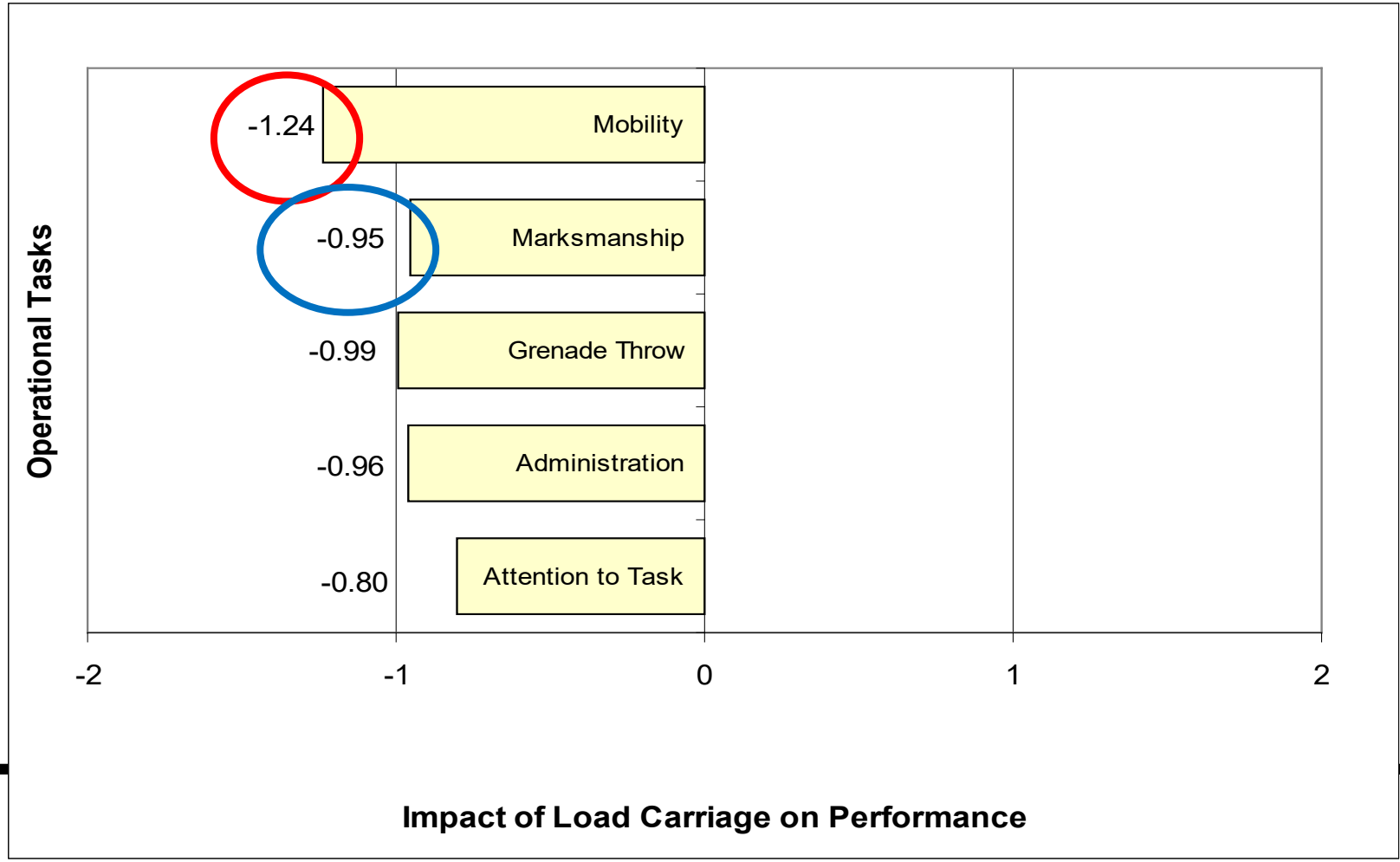
- Decrements in performance:
  - ↓ Marksmanship (Knapik et al., 1990:1991:1997: Rice et al., 1999).

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MARKSMANSHIP

- **Reduced performance**
  - Survey of 218 soldiers on operations

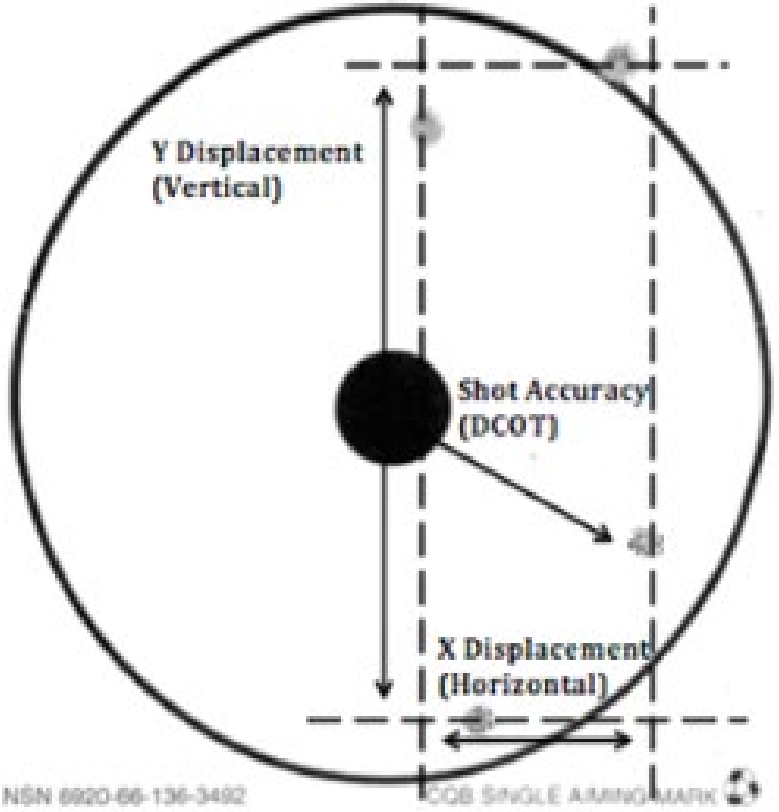
(Orr et al., 2013)



BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MARKSMANSHIP

- Distance to centre of target
  - DCOT
- Horizontal shot spread
  - X-Dispersion
- Vertical shot spread
  - Y-Dispersion

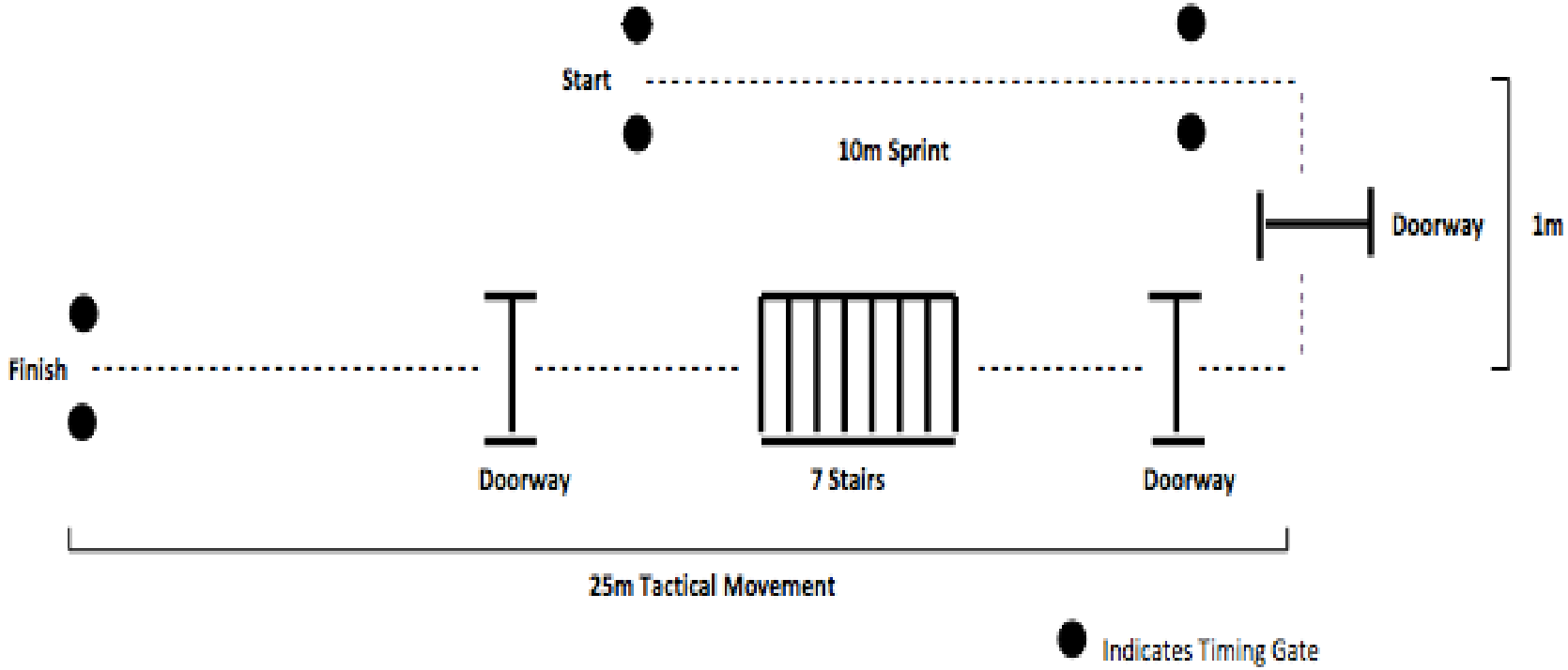


Carbone et al., 2014

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

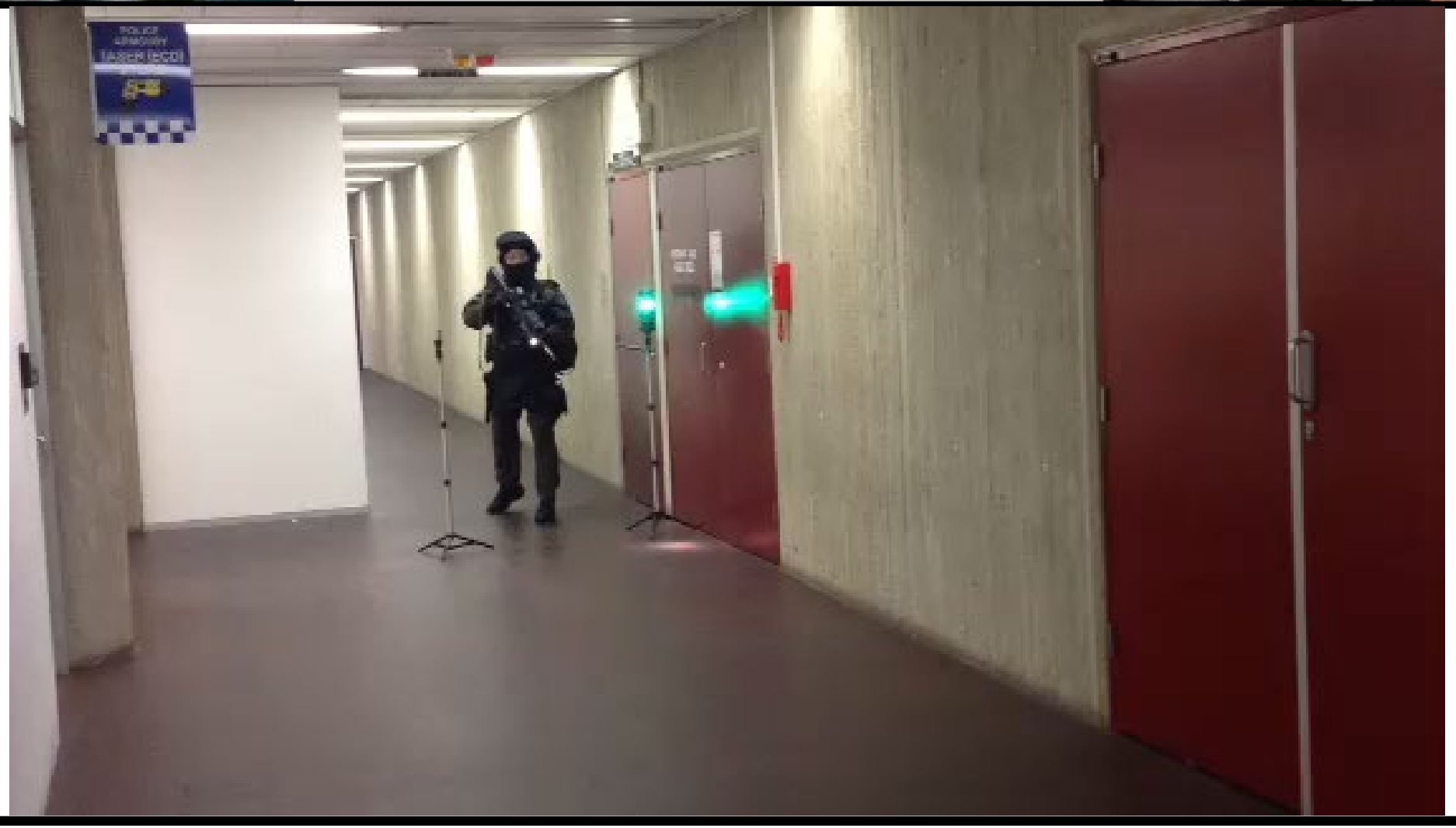
IMPACTS ON PERFORMANCE - MARKSMANSHIP

- Mobility Task



Carbone et al., 2014

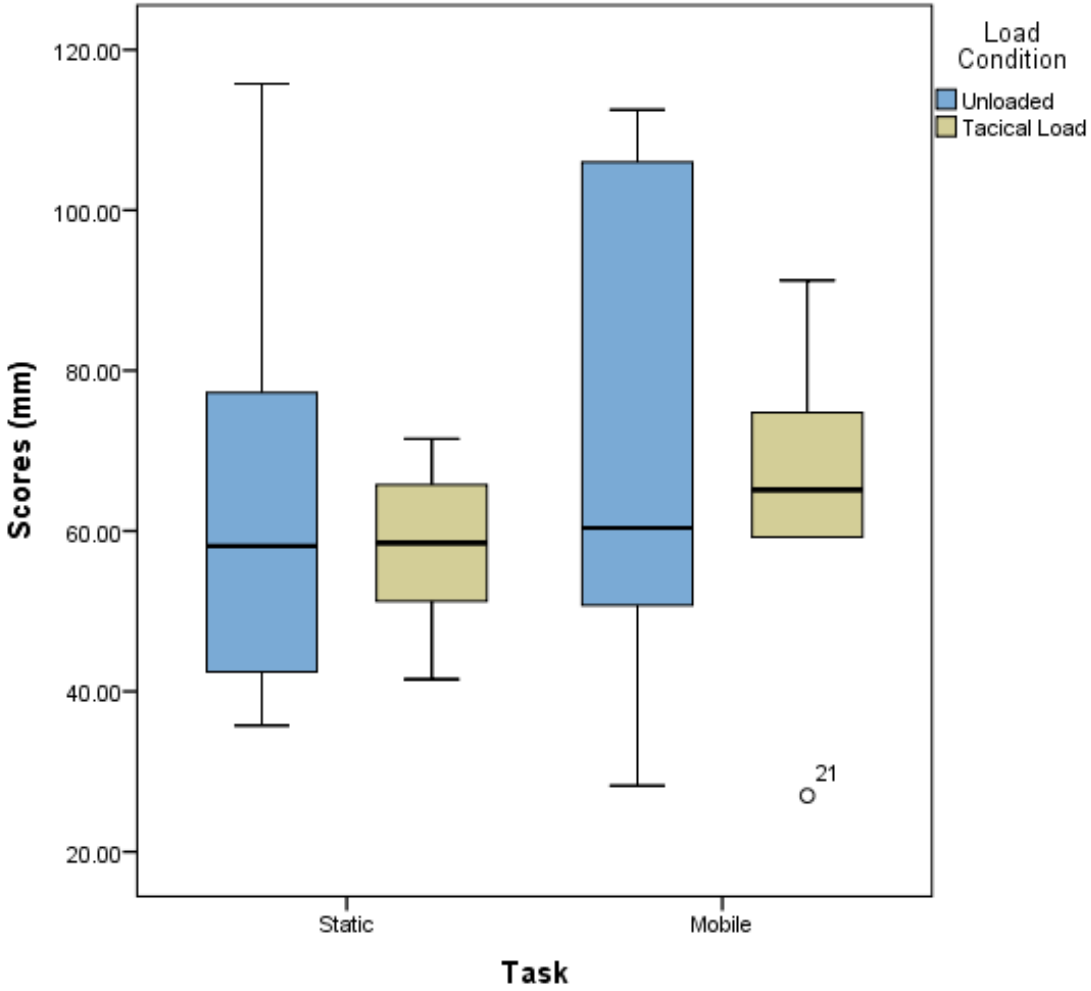
BOND UNIVERSITY
TACTICAL RESEARCH UNIT



BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MARKSMANSHIP

- Marksmanship



Carbone et al., 2014

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MARKSMANSHIP

- No significant difference when TL

Table 1. Primary weapon marksmanship results from all four conditions

Task & Loading Condition	DCOT (mm)	X-Dispersion (mm)	Y-Dispersion (mm)
Short Forward Movement			
Fatigues Only	75.93 ± 17.97	112.50 ± 31.35	143.58 ± 44.88
Tactically Loaded	70.48 ± 19.57	76.42 ± 46.99	168.42 ± 50.39
Mobility Task			
Fatigues Only	74.83 ± 36.95	116.67 ± 70.05	173.25 ± 139.65
Tactically Loaded	100.10 ± 20.14	112.50 ± 51.59	213.67 ± 70.99

Data are mean ± standard deviation

Table 2. Secondary weapon marksmanship results from all four conditions

Task & Loading Condition	DCOT (mm)	X-Dispersion (mm)	Y-Dispersion (mm)
Short Forward Movement			
Fatigues Only	107.35 ± 37.68	178.33 ± 81.62	206.33 ± 85.87
Tactically Loaded	112.60 ± 44.37	128.83 ± 59.55	188.25 ± 60.23
Mobility Task			
Fatigues Only	128.23 ± 33.20	157.00 ± 70.43	274.08 ± 176.61
Tactically Loaded	108.70 ± 52.48	176.25 ± 70.13	212.08 ± 131.60

Orr et al., Unpublished

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MARKSMANSHIP

- Visual Analogue Scale (VAS)

Subject Number ST

How do you think tactical load impacts on your marksmanship with the pistol when compared to carrying no load:

-10 0 +10

Worse No Change Better

How do you think tactical load impacts on your marksmanship with the rifle when compared to carrying no load:

-10 0 +10

Worse No Change Better

Orr et al., Unpublished

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MARKSMANSHIP

- Perceived significant improvement in marksmanship when TL
  - Primary – VAS +3.00 ± 2.53 (p = 0.016)
  - Secondary – VAS +2.83 ± 2.93, (p = 0.039)
- Correlations between perceptions of load carriage impacts on performance and actual marksmanship scores
  - Primary: Short move: r = -0.347, (p = 0.500) and mobility task: r = -0.401 (p = 0.431)
  - Secondary: Short move: r=-0.631 (p = 0.179) and mobility task: r = -0.306, (p = 0.555)

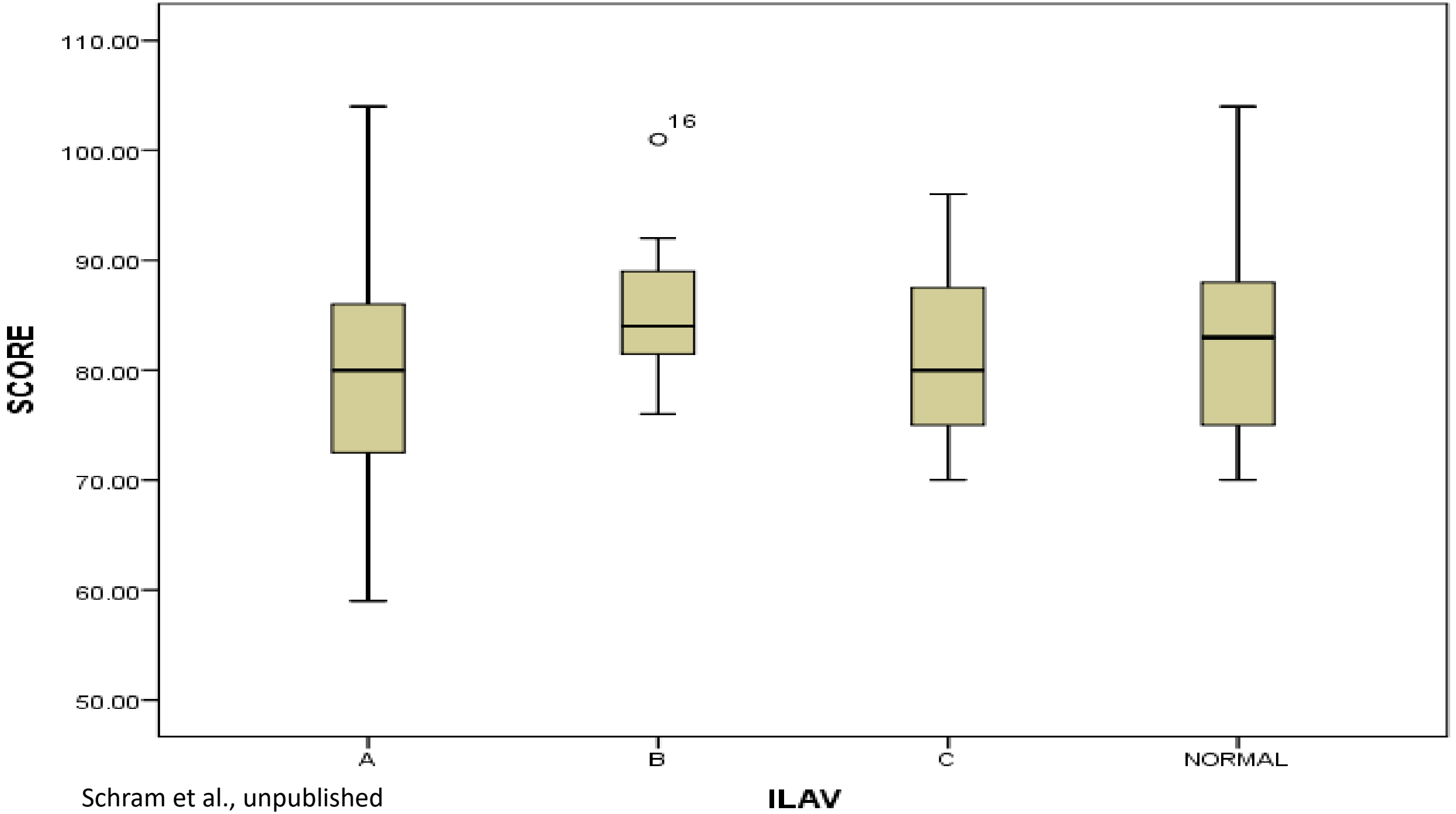
Orr et al., Unpublished

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MARKSMANSHIP

- GD police (n=11)
  - Average marksmanship scores (p=.118)
  - ILAV B – smallest SD,
    - ILAV A: a negative impact, -2.1 (95% CI -5.5 to +1.3)
    - ILAV B: a positive impact, +2.7 (95% CI +0.4 to +5.0)
    - ILAV C: a negative impact, -1.7 (95% CI -4.4 to +0.9)
    - Normal station wear: a positive impact, +1.4 (95% CI -2.2 to +5.0)

Schram et al., unpublished



Schram et al., unpublished

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MOBILITY

- Decrements in performance:
  - ↓ **Mobility**
    - Impeded mission success (Breen 2000)

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MOBILITY

- Victim Drag (10m)
- Police Vehicle Exit and Sprint

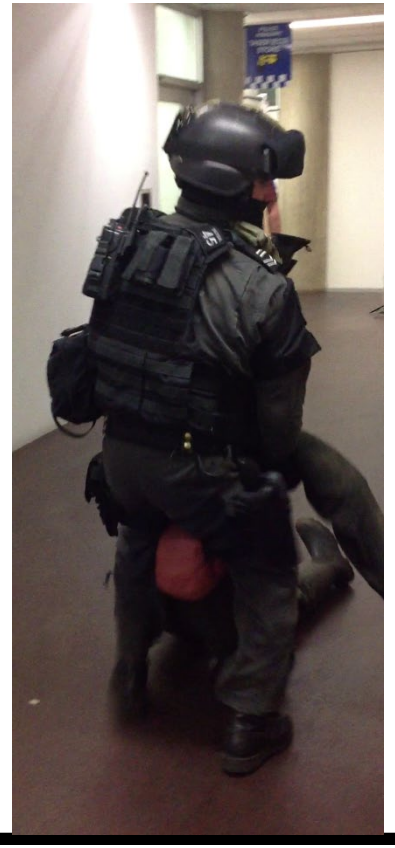
Schram et al., unpublished

	Victim Drag	**Vehicle Exit**
Condition	Time (s)	Time (s)
ILAV A	5.74±0.28	3.49±0.94
ILAV B	5.47±0.23	3.41±0.87
ILAV C	5.50±0.38	3.40±1.06
N	5.56±0.43	3.41±0.85

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

IMPACTS ON PERFORMANCE - MOBILITY

	Unloaded	Loaded
10m sprint (sec)	2.40 ± 0.22	2.46 ± 0.15
10m dummy drag (sec)	6.89 ± 0.44	7.79 ± 0.75*
Total time (sec)	9.29 ± 0.53	10.25 ± 0.77*



* Indicates statically significant differences between unloaded and loaded, $p<0.01$.

Carlton et al., 2014

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

ENCAPSULATION

- Loads for both LEO and Army are increasing
- Female soldiers carry lighter absolute but similar relative loads
- Female LEO carry similar absolute but heavier relative loads
- There are differences in injuries sustained based on sex
- There are different impacts of load on marksmanship (primary / secondary weapon)
- Soldiers think load reduces marksmanship, LEO varies but appear accurate
- Load impacts on mobility – but the load may need to reach a threshold

BOND UNIVERSITY
TACTICAL RESEARCH UNIT

Australian Tactical Loads and their Operational Impacts

References avail on request from

tru@bond.edu.au